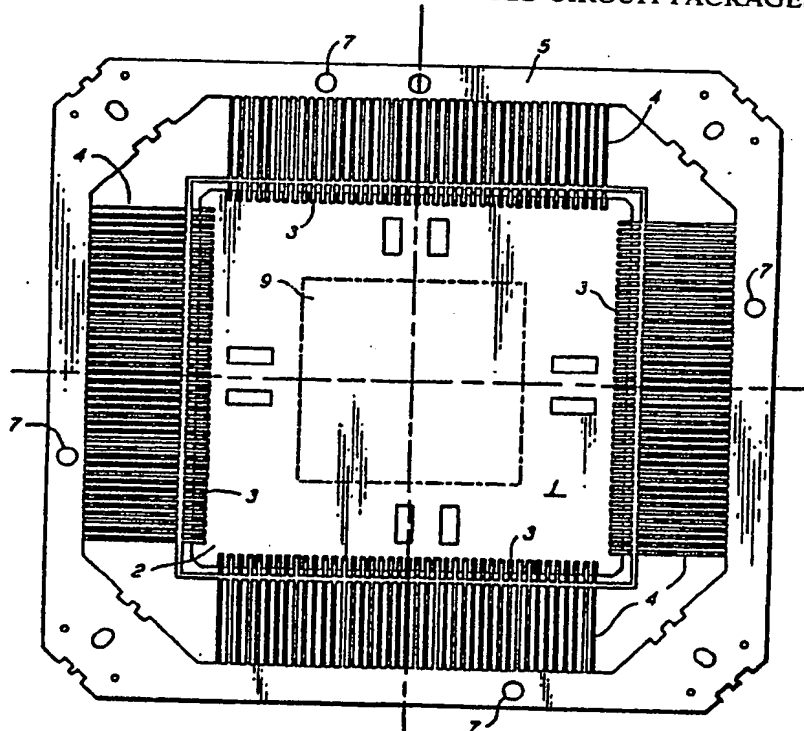




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(21) International Application Number: PCT/US89/00727 (22) International Filing Date: 22 February 1989 (22.02.89) (31) Priority Application Number: 161,914 (32) Priority Date: 29 February 1988 (29.02.88) (33) Priority Country: US (71) Applicant: DIGITAL EQUIPMENT CORPORATION [US/US]; 146 Main Street, Maynard, MA 01754 (US). (72) Inventors: SCHLESINGER, Randall, Lee ; R.R. #1 #205 Bullard, Oakham, MA 01068 (US). EASTMAN, Kevin, M. ; 261 Sandy Pond Road, Lincoln, MA 01773 (US). PALINO, Douglas, F. ; 2 Hill Road, Marlboro, MA 01752 (US).		(74) Agents: SOLOWAY, Norman, P. et al.; Hayes, Soloway, Hennessey & Hage, 175 Canal Street, Manchester, NH 03101 (US). (81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent). Published <i>With international search report.</i>

(54) Title: ALIGNMENT OF LEADS FOR CERAMIC INTEGRATED CIRCUIT PACKAGES

**(57) Abstract**

An alignment system comprising a rectangular leadframe (5) from the interior of which extend leads (4) to terminations arrangement for alignment and registration with the braze pads (3) of ceramic integrated circuit package (1), the alignment and registration being maintained and defined by a web bar (6) interconnecting the leads adjacent and between those braze pads and the leadframe. The leadframe, leads and web bar are integrally formed preferably by etching and preferably lie in a plane.

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ALIGNMENT OF LEADS FOR CERAMIC INTEGRATED CIRCUIT PACKAGES

The present invention relates to the alignment of leads during brazing of these leads to connecting pads of ceramic integrated circuit (hereinafter IC) packages.

BACKGROUND OF THE INVENTION

5 Until the present invention, leads to be brazed onto braze pads of leadless IC packages have been positioned by means of a leadframe, from which the leads project inwardly in the plane of the frame, over the braze pads for brazing thereto. With this cantilever arrangement of
10 leads, a positioning tolerance of ± 0.005 inches at the ends of the leads to be attached to the braze pads is difficult to improve upon. With fine pitch lead connections on ceramic packages, a positioning tolerance at the connection is desirably ± 0.002 inches. One
15 proposal to achieve support. However, such a method is relatively expensive, not totally effective and rather complex to achieve in view of the braze pad spacing on such fine lead pitch packages of only 0.025 inches center to center. In another prior art proposal, a snap-off tie
20 bar which ties all of the leads together at their very tip is proposed. At the braze pads, the tie bar extends up off the ceramic package so that it may be snapped off after brazing. Each lead is necked down at its connection with the tie bar to allow the tie bar to be easily snapped
25 off. A disadvantage of this arrangement is that the tie bar leaves only two sides of the lead exposed for brazing onto the braze pad with the end of the lead being prevented from forming part of the brazed joint because of its connection with the tie bar. In addition this
30 arrangement leaves "pigtails" of metal after tie bar removal leading to handling and space utilization problems. Further, the tie bar concept requires special handling for removal of the tie bar and an additional step in the production of the leadframe because of the

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requirement that the tie bar be shaped to extend off of the ceramic package to facilitate its removal. The special handling for removal of the tie bar also involves additional steps.

- 5 It is known in the production of plastic IC packages, in which a leadframe is used to connect leads, which extend through the molded plastic package to the chip housed therein, to use a dam bar interconnecting the leads in the plane of the leadframe to act as a dam to limit the
10 flow of plastic during injection molding of the package. This is necessary as the two molds halves are clamped together with the leads projecting through an opening between them thereby leaving gaps between the leads and the mold halves through which the plastic can extrude
15 during molding. The dam bar prevents any significant flow of plastic resulting from this. The dam bar is then removed by punching operation and the small amount of extruded plastic projecting from the package is also removed.
- 20 It is an objection of the present invention to provide enhanced lead alignment capable of providing the desired positioning tolerance between the ends of leads while they are brazed to braze pads of fine pitch ceramic IC packages and of improving dissipation of heat generated by this
25 brazing.

SUMMARY OF THE INVENTION

- According to one aspect of the invention there is provided an alignment system for defining alignment and registration of leads during attachment of those leads to
30 a ceramic IC package comprising a leadframe, a plurality of leads extending inwardly from and supported by said leadframe to lead terminations positioned for registration of said terminations with lead attachment points on a said package for attachment thereto and a web bar
35 interconnecting said leads adjacent their terminations between said terminations and said leadframe.

According to a second aspect of the invention there is provided a ceramic IC package in combination with an alignment for defining alignment and registration of leads during attachment of those leads to the ceramic IC package comprising a leadframe, a plurality of leads extending inwardly from and supported by said leadframe to lead terminations positioned for registration of said terminations with lead attachment points on a said package for attachment thereto and a web bar interconnecting said leads adjacent their terminations between said terminations and said leadframe, said lead terminations being attached to said attachment points.

According to a third aspect of the invention, there is provided a method of providing desired alignment and registration of lead terminations of leads, supported by a leadframe, with attachment points on ceramic IC package, comprising the steps of interconnecting the leads adjacent their terminations between said terminations and said leadframe, bringing said terminations into alignment and registration with said attachment points, attaching said lead terminations to said attachment points while so aligned and registered and subsequently removing said interconnections.

According to a fourth aspect of the invention there is provided a product made by the method of the preceding paragraph.

The present invention enhances the positioning tolerance of the ends of leads for brazing to braze pads of fine pitch ceramic IC packages. It permits improved alignment of these leads with respect to the package and with respect to adjacent leads. This improved alignment of the leads at the braze points translates to improved true-positioning or lead registration at the printed circuit board interface upon surface mounting of the finished device. Additionally, the web bar arrangement increases dissipation of heat generated by the brazing

process and reduces warpage during cooling. The invention preferably provides these enhancements using a planar leadframe construction in which the frame, leads and the web bar are integral. This provides an economical
5 produced, simple, extremely effective arrangement.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

10 Figure 1 is a plan view of a leadframe with the web bar of the present invention shown after brazing to a fine lead pitch ceramic IC package;

Figure 2 is an enlarged portion of one corner of the leadframe illustrated in Figure 1; and

15 Figure 3 is a section along section line 3-3 shown in Figure 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference first to the drawings, a fine lead pitch ceramic IC package 1, square in plan, carries on its
20 face 2, a row of braze pads 3 adjacent each of its four edges. The braze pads are evenly spaced apart with their centers spaced by 0.025 inches plus/minus 0.002 inches. Within the package 1 of the braze pads are connected as appropriate to the IC 9 housed therein, by connections 8
25 (see Figure 3). A plurality of leads 4 terminate at and are brazed to the braze pads with each lead brazed on both of its sides and its end at its termination. The leads 4 associated with each of the four sides of the package 1 are parallel to one another, lie in a plane and extend
30 normal to their associated side of the package. The leads are preferably a gold or nickel plated iron-nickel-cobalt alloy such as that sold under the trademark KOVAR by Westinghouse Electric Corporation. The leads are supported at their outer ends, the ends remote from those
35 brazed to the braze pads, by a leadframe 5 lying in the plane of the lead 5. This frame 5 connects all of the

leads from all four sides of the package 1 together to provide alignment of the leads and support during assembly including brazing to the braze pads. Adjacent the four sides of the package 1 a web bar 6 lying in the plane of the leads 4 and the leadframe 5 interconnects all of the leads. The web bar comprises four portions, one for each side of the package with the four web bar portions being jointed at the corners of the package 1. The leadframe 5, leads 4 and web bar 6 are integral and are typically produced by etching as an entirely separate step from the ceramic package producing process. The manner of producing this integral structure will be well known to those skilled in the art.

The leadframe is spaced from the braze pads by approximately 0.285 inches while the web bar 6 is spaced from the brazed points by approximately 0.060 inches thereby to provide an improvement in alignment and registration of the inner terminal ends of the leads 4 with respect to the braze pads.

Preparatory to the brazing operation, the integral structure comprising the leads 4, leadframe 5 and web bar 6 are brought into alignment and registration with the braze pads and held in that alignment while the inner terminal ends of the leads 4 are brazed onto the braze pads of the ceramic package 1 at a furnace temperature of between 800 and 1,000 degrees C.

After brazing the web bars are mechanically removed using a punch trim tool. The trim tool is aligned with the leads for accurate removal of the web bar by means of tooling holes 7 in the leadframe 5. Subsequently, the leads are trimmed from the leadframe and deformed, from the plane they line in during assembly, into a gull-wing form to facilitate surface mounting of the package 1 onto a printed circuit board.

The surface mounting of the ceramic IC package is facilitated by the accurate alignment and registration of

the formed leads relative to lands on the printed circuit boards for soldering thereto. Accurate placement of the leads to the land's provides increased surface mount yields, and consequently increased yields of the printed circuit board assemblies. Tight tolerancing of the leads in relation to one another (true-positioning) as is provided by the present invention after forming of the leads is imperative to meet the alignment and registration requirements of printed circuit boards.

10 Prior to the present invention with its utilization of the web bar 6, the relationship with one lead to the next lead was specified as 0.25 inches \pm 0.005 inches. With the web bar 6 disposed approximately 0.60 inches away from the braze pads, a highly desirable and tighter tolerance
15 of 0.025 inches \pm 0.002 inches is possible. The improved lead positioning at the brazed point translates to tighter tolerances at the end of the lead when the outer web bar is removed and the leads are formed for attachment to the printed circuit board.

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WE CLAIM:

1. An alignment system for defining alignment and registration of leads during attachment of those leads to a ceramic IC package characterized by a leadframe (5), a plurality of leads (4) extending inwardly from and supported by said leadframe to lead terminations positioned for registration of said terminations with lead attachment points (3) on a said package (1) for attachment thereto and a web bar (6) interconnecting said leads adjacent their terminations between said terminations and said leadframe.

2. An alignment system according to claim 1 characterized in that said leadframe, said leads and said web bar are in integral planar structure, said leadframe (5) preferably being rectangular and having a plurality of leads (4) extending parallel with one another from each of four sides of said leadframe (5) for respective alignment and registration with lead attachment points (3) on each of four sides of a rectangular said package (1).

3. An alignment system according to claim 2 characterized in that said attachment points are braze pads (3) and said system is for alignment and registration of said lead terminations with said pads during attachment thereto by brazing.

4. An alignment system according to claim 3 characterized in that said web bar (6) is spaced approximately 0.060 inches from said braze pads (3).

5. An alignment system according to claim 2 characterized in that the web bars (6) associated with each said plurality of leads are joined to form a rectangular web bar frame to surround a said package (1) during attachment of said leads (4) to said attachment points.

6. A ceramic IC package in combination with an alignment system for defining alignment and registration of leads during attachment to those leads to the ceramic

IC package characterized by a leadframe (5), a plurality of leads (4) extending inwardly from and supported by said leadframe to lead terminations positioned for registration of said terminations with lead attachment points (3) on a
5 said package for attachment thereto and a web bar (6) interconnecting said leads (4) adjacent their terminations between said terminations and said leadframe (5), said lead terminations being attached to said attachment points.

10 7. A combination according to claim 6 characterized in that said leadframe, said leads and said web bar are an integral planar structure, said leadframe (5) preferably being rectangular and having a plurality of leads (4)
15 extending in parallel with one another from each of four sides of said leadframe for respective alignment and registration with attachment points (3) on each of four sides of a rectangular said package (1).

8. A method of providing desired alignment and registration of lead terminations of leads, supported by a
20 leadframe, with attachment points on a ceramic IC package, characterized by the steps of interconnecting the leads adjacent their terminations between said terminations and said leadframe, bringing said terminations into alignment and registration with said attachment points, attaching,
25 preferably by brazing, said lead terminations to said attachment points while so aligned and registered and subsequently removing said interconnections, preferably by punching.

9. A method according to claim 8, characterized by
30 the step of removing the leadframe following said attaching.

10. A method according to claim 8, characterized by the step of forming the leads for alignment and registration with attachment points on a printed circuit
35 board following said attaching.

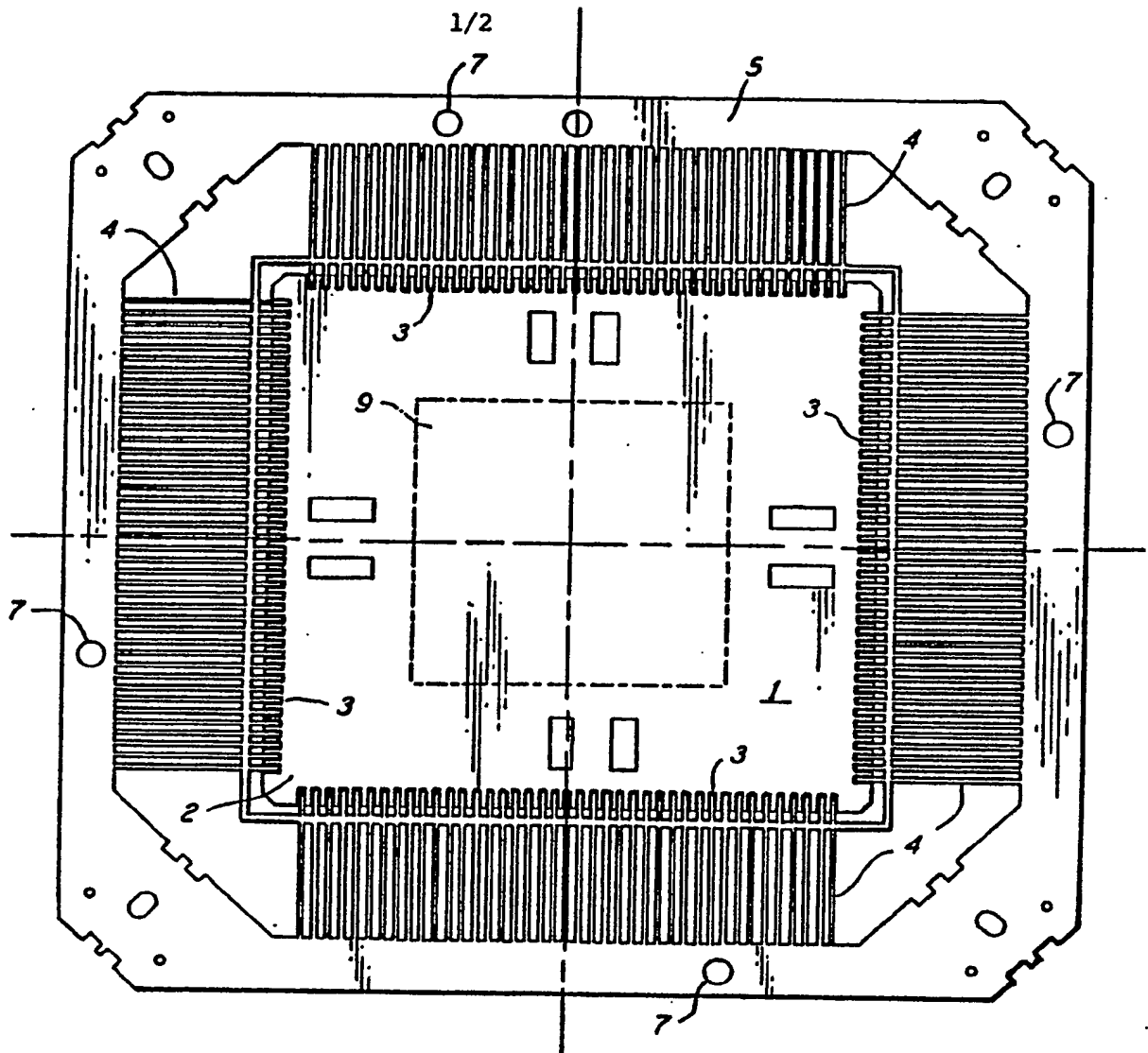


FIG. 1

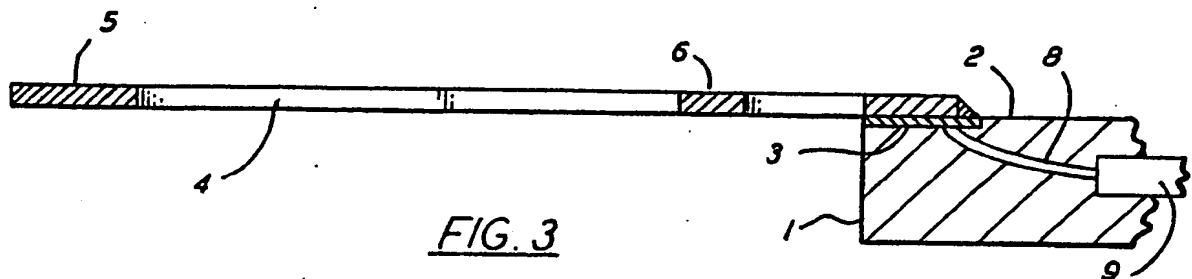
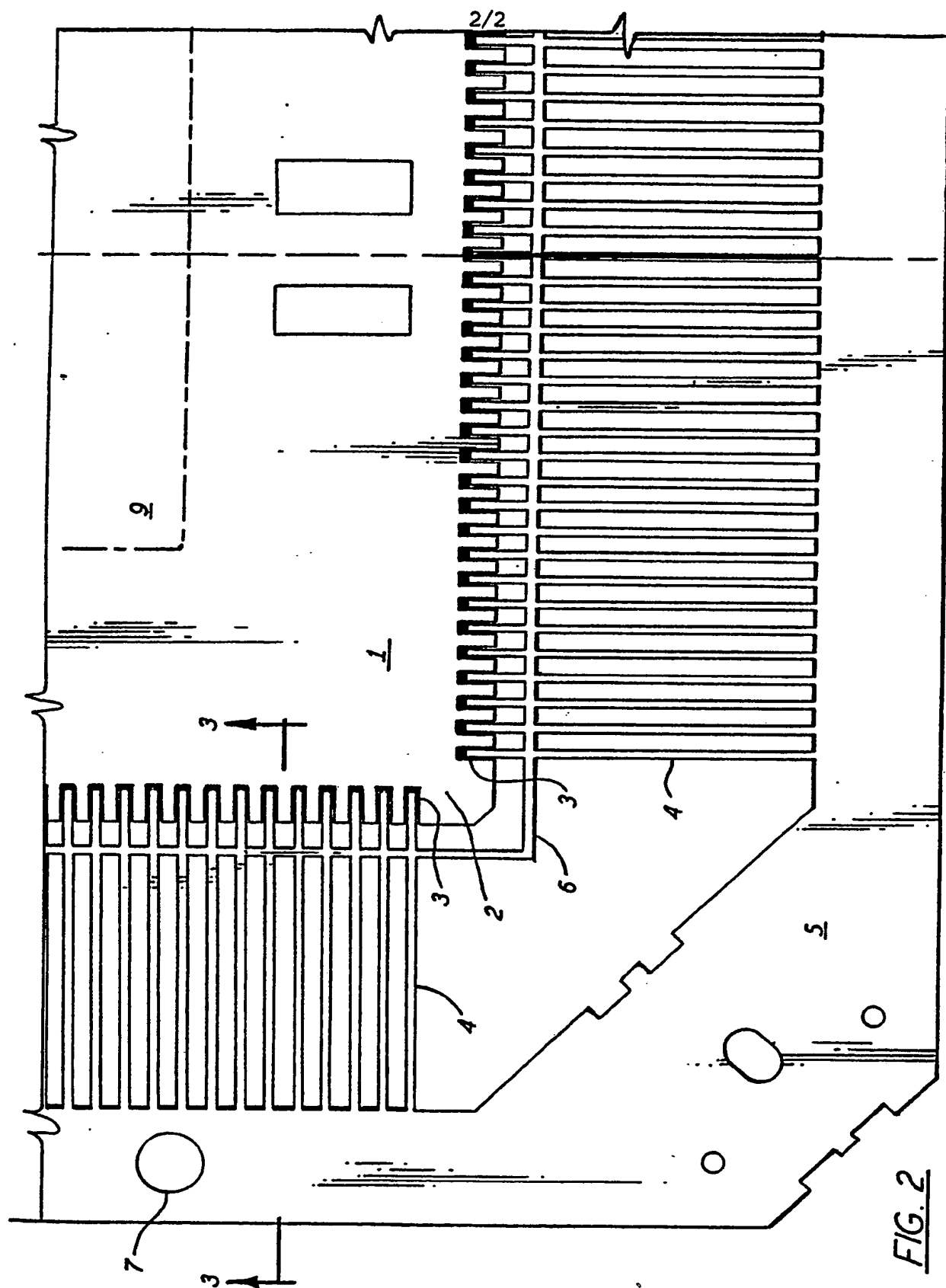


FIG. 3

SUBSTITUTE SHEET



INTERNATIONAL SEARCH REPORT

International Application No PCT/US 89/00727

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) * According to International Patent Classification (IPC) or to both National Classification and IPC IPC ⁴ : H 01 L 21/48; H 01 L 23/50																							
II. FIELDS SEARCHED <div style="text-align: center; margin-top: 10px;">Minimum Documentation Searched ⁷</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%; border-bottom: 1px solid black; padding: 5px;">Classification System</td> <td style="border-bottom: 1px solid black; padding: 5px;">Classification Symbols</td> </tr> <tr> <td style="border: 1px solid black; padding: 10px; vertical-align: top;">IPC⁴</td> <td style="border: 1px solid black; padding: 10px; vertical-align: top;">H 01 L</td> </tr> </table> <div style="text-align: center; margin-top: 10px; font-size: small;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸</div>			Classification System	Classification Symbols	IPC ⁴	H 01 L																	
Classification System	Classification Symbols																						
IPC ⁴	H 01 L																						
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black; padding: 5px;">Category ⁹</th> <th style="width: 70%; border-bottom: 1px solid black; padding: 5px;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 20%; border-bottom: 1px solid black; padding: 5px;">Relevant to Claim No. ¹³</th> </tr> <tr> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="border: 1px solid black; padding: 5px;">GB, A, 2079534 (FAIRCHILD) 20 January 1982, see figures 3,4; claims 1,11</td> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> <tr> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">--</td> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">2,3,6-8,10</td> </tr> <tr> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="border: 1px solid black; padding: 5px;">US, A, 4626478 (UNITRODE) 2 December 1986, see figures 1A,1B; column 2, line 54 - column 3, line 13</td> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> <tr> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">--</td> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">2,3,6-8,10</td> </tr> <tr> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="border: 1px solid black; padding: 5px;">US, A, 4289922 (PLESSEY) 15 September 1981, see figures 2,3; claims 1,2</td> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> <tr> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">-----</td> <td style="border: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">2,3,5,8</td> </tr> </table>			Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	X	GB, A, 2079534 (FAIRCHILD) 20 January 1982, see figures 3,4; claims 1,11	1	A	--	2,3,6-8,10	Y	US, A, 4626478 (UNITRODE) 2 December 1986, see figures 1A,1B; column 2, line 54 - column 3, line 13	1	A	--	2,3,6-8,10	Y	US, A, 4289922 (PLESSEY) 15 September 1981, see figures 2,3; claims 1,2	1	A	-----	2,3,5,8
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A	-----	2,3,5,8																					
<div style="display: flex; justify-content: space-between; font-size: x-small;"> <div style="width: 45%;"> <p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p> </div> </div>																							
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of the Actual Completion of the International Search</td> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of Mailing of this International Search Report</td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px; text-align: center;">2nd June 1989</td> <td style="border-bottom: 1px solid black; padding: 5px; text-align: center;">23 JUN 1989¹</td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px;">International Searching Authority</td> <td style="border-bottom: 1px solid black; padding: 5px;">Signature of Authorizing Officer</td> </tr> <tr> <td style="padding: 5px; text-align: center;">EUROPEAN PATENT OFFICE</td> <td style="padding: 5px; text-align: center;"> P.C.G. VAN DER PUTTEN </td> </tr> </table>			Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	2nd June 1989	23 JUN 1989 ¹	International Searching Authority	Signature of Authorizing Officer	EUROPEAN PATENT OFFICE	 P.C.G. VAN DER PUTTEN													
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

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SA 27376

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A- 2079534	20-01-82	DE-A- 3123844	08-04-82
		FR-A- 2486307	08-01-82
		JP-A- 57045263	15-03-82
		NL-A- 8102871	01-02-82
US-A- 4626478	02-12-86	None	
US-A- 4289922	15-09-81	None	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82